

## A methodology for cross-unit integration of new topics within an existing course structure

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For a technology based education program, changes to the curriculum are an inevitable response to changes in technology and industry practices. These changes can be difficult to accommodate within an existing course structure. For example, if the change warrants the addition of a new unit, which unit can be deleted to accommodate it? If the new technology requires pre-requisite knowledge, can this be accommodated within the existing unit structure and dependencies? Even if these issues prove trivial, many educational institutions have bureaucratic obstacles to change. Curriculum committees, planning schedules and the need to consider students who are part way through an educational program, are all impediments to rapid structural change. This paper presents an alternative strategy whereby new topics may be added through their integration within existing unit and course structures. A methodology to facilitate this process is also presented.

**Keywords** course; topic; unit; development; methodology; education

### 1. Introduction

Most degree level ICT courses<sup>1</sup> follow a structure that consists of a number of core units<sup>2</sup> with sets of area specific units and sets of optional units. The goal of the core units is to achieve graduates with a broad technological background who can converse with other professionals in their discipline area [1]. The area specific units are designed to provide the graduate with deeper technical knowledge on which they can base their professional area of expertise. To achieve this depth, areas of specialisation should build on the fundamental skills and knowledge obtained in the core units and hence unit dependencies and prerequisites arise.

When changes in technology and industry practice occur it is essential that ICT courses change their curriculum in response [2]. For short term industry trends or discrete technologies it may be appropriate to add another area specific unit or an optional unit, depending on the importance of the new technology to the discipline area. An example of a short term unit might have been a unit on Y2K in late 90's. Many respected guidelines for curriculum development advocate the incorporation of new or novel technology through optional units [2]. For some changes in technology the addition of another unit may well be justified, however in many instances waiting for sufficient justification or demand for a new unit may result in degree programs that are constantly dated. Furthermore, many educational institutions face barriers to the addition of new units such as: bureaucratic delays as proposals for new units are subjected to scrutiny and approval by curriculum committees; financial concerns regarding the provision of additional lectures and tutorials; and difficulty accommodating a new unit within an existing course structure given that courses are often made up of fixed numbers of units, often with strict sequencing and dependencies.

It can also be argued that covering a change in technology with the addition of a single new unit may not be pedagogically sound. Particularly if the new technology is pervasive and impacts on the material taught in other units. In this case, rather than introduce a new unit, it may be more appropriate to vary

<sup>1</sup>In this paper a unit refers to a single subject within an educational program. EG Introduction to Data Communications is a „unit“.

<sup>2</sup>In this paper a course refers to a program of study leading to an award. EG a Bachelor of Science in Internetworking and Security is a course.

the content of several existing units in order to produce a more coherent educational package that reinforces the new technologies place within the discipline.

In effect the technological change needs to be treated not as a topic but as an underlying context. This isn't a trivial exercise and almost every educational institution has at one time or another attempted to improve graduate attributes [3] across units and courses in areas such as numeracy and critical thinking only to discover the enormity of the task.

This paper presents a methodology (figure 1) that was used to facilitate the addition of Voice over IP (VoIP) into an Internetworking and Security bachelor degree course. While the paper uses examples relating to the communications industry, the proposed methodology is applicable to a wide range of technologies and educational environments. As the reader is taken through the steps of the methodology specific example relating to the VoIP project will be detailed.

## **2. Methodology**

### 2.1 Sources of learning objectives

The first step in modifying an existing course is knowing what new topics or learning objectives are to be included. It is important to use an objective source of potential topics as there is the temptation to choose only those new learning objectives which have an obvious fit with the existing offering. This may lead to an incomplete or biased coverage of the new topic or technology. Sources of potential learning objectives include the course developers existing experience, consultation with industry groups, government industry skills reports, text books and the stated objectives of relevant industry certification programs.

#### 2.1.1 VoIP project example

Sources of learning objectives for the VoIP integration project included training materials used by industry short courses on IP telephony, existing knowledge and the exam objectives of the Cisco Certified Voice Professional certification exam.

#### 2.2 Potential learning objectives

None of the sources of learning objectives is likely to be completely objective and thus using several will give the course developer a richer view of the components of the new technology that is to be added. After looking to several sources to define learning objectives, an aggregate list of potential learning objectives is produced.

#### 2.3 Determine learning objectives for inclusion

It is unlikely that all of the learning objectives obtained in step 2.2 will, or should be, included in the altered units. Some objectives will be too narrow or specialised for inclusion while others may need to be rejected in order to keep the inclusions to a manageable size.

In determining which learning objectives to keep the educational context will need to be considered. Does the course have sufficient scope to encompass all of the elements of the new technology or should only some aspect of the new technology be covered? Are there learning objectives that cannot be covered because there is a lack of resources, equipment or expertise? At the end of this process the goal is to have a cohesive set of learning objectives that adequately cover the new technology in the context of the educational program in which they are embedded.

In the process of determining the learning objectives to be included, some will be rejected for non - pedagogical reasons. While this is not desirable, at least it is explicitly recognised.

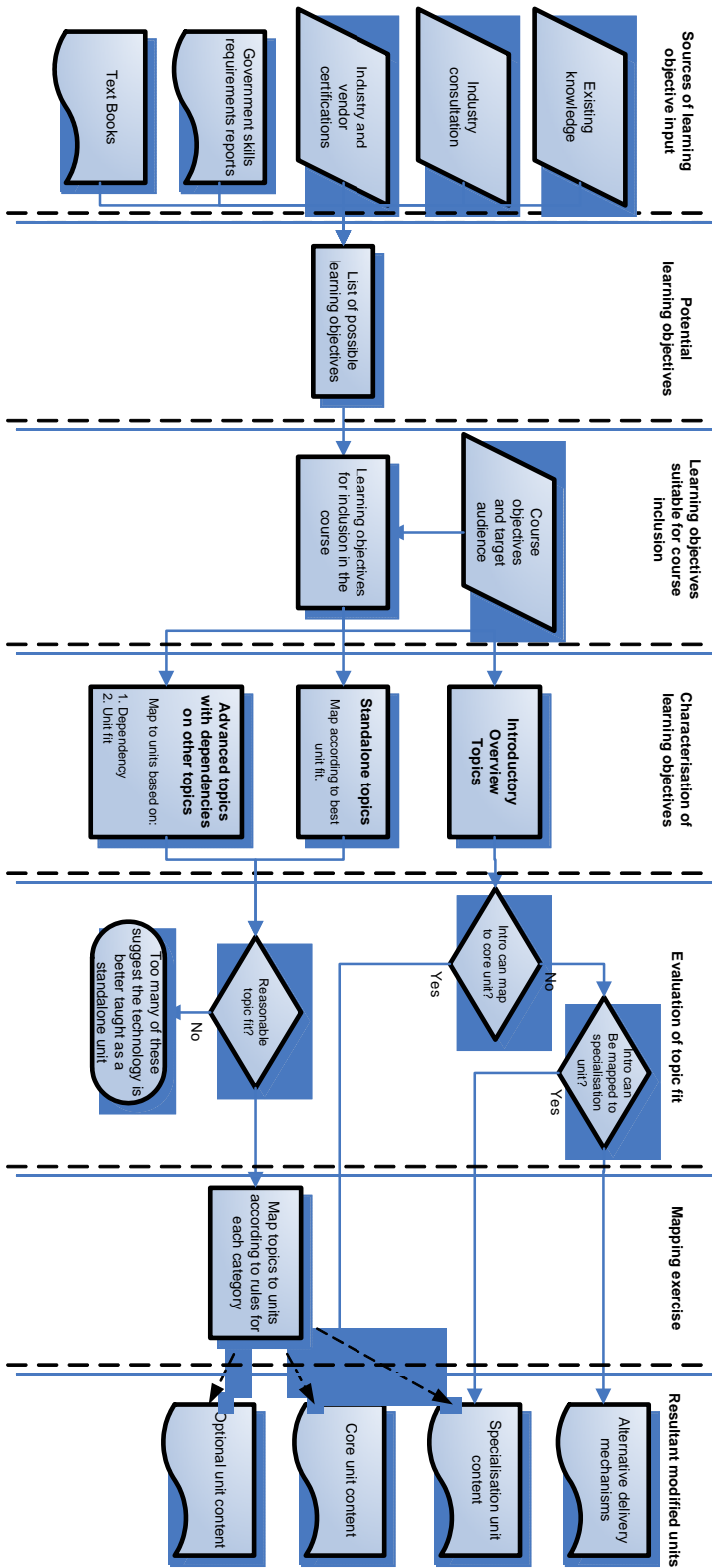


Figure 1. methodology for cross-unit integration of new topics within an existing course structure

### 2.3.1 VoIP project example

Looking over the list of VoIP learning objectives, two broad areas of learning objectives were problematic. One common theme amongst all of the sources was quite an extensive treatment of legacy PABXs both as an introduction to telephony and in terms of integration with VoIP. This would present problems in terms of laboratory equipment, instructor expertise and the existing scope of the Internetworking and Security degree. It was decided that although the history of the PBX as a legacy device could be accommodated within an introductory topic, detailed issues surrounding legacy PBX and VoIP integration would be dropped. This reinforced the fact that while we wanted graduates who were conversant with VoIP technology and could manage VoIP traffic as part of a converged network, we were not aiming to produce telephony specialists.

The second area of concern was the focus on proprietary call management servers. Although the text book was fairly generic in this regard, the certification emphasised Cisco's "Call Manager" product. As a learning objective, experience working with a call management server was an important part of VoIP and there was an argument for including Call Manager™ as it is a widely implemented system. This was balanced against resources and the decision was made to use an open source VoIP PBX called Asterisk. As a result the learning objectives were made more generic or Asterisk oriented.

### 2.4 Characterisation of learning objectives.

Each topic or learning objective can be characterised as introductory, standalone or advanced. By characterising topics in this way it is possible to determine an appropriate order of topics and unit mappings.

An Introductory learning objective has no prerequisite knowledge and establishes basic understanding of the technology upon which more advanced learning objectives can be built. Consequently introductory topics need to be embedded early in the unit structure of a course. Ideally introductory topics will be associated with core units but in some cases core units may be too broad to accommodate detailed technical content and it may be more appropriate to map the topic to an area specific unit.

A standalone learning objective is one with few requirements for prerequisite knowledge and upon which other learning objectives are not dependent. The main objective in mapping these topics to units is to achieve the best fit.

An advanced learning objective builds upon previous learning objectives and thus topics that fit into this category are mapped principally on the basis of satisfying dependencies. In all instances it is desirable to map these topics to core or area specific units but it may be necessary to compromise and map them to an optional unit based on exceptional fit.

### 2.5 Evaluation of topic fit and mapping learning objectives to existing units

In the case of introductory learning objectives it is necessary to map the topic to a core or area specific unit to ensure students have covered the material prior to more advanced topics. Fortunately introductory topics tend to be sufficiently general that this is unlikely to present a problem. If an introductory topic simply can't be mapped to one of these units then it will be necessary to find an alternate means of delivering this content to students such that they receive introductory training prior to more advanced topics. One example is a pre-recorded lecture that students view in their own time if they do not have sufficient background in the technology.

Standalone and advanced learning objectives should be evaluated for fit with existing units. Where an appropriate fit is not possible then some learning objectives may need to be dropped from the course. If a significant number of learning objectives are dropped then it would be wise to re-examine the scope of the new technology inclusion. Perhaps a more limited but cohesive coverage can be accommodated. In

the worst case this may be an indication that the new technology simply can't be taught across existing units and it may be necessary to add a new unit.

### 2.5.1 VoIP project example

A basic introduction to VoIP made sense as an inclusion to the single core data communications unit common to Murdoch University's School of IT offerings. However, there simply was no room for another topic. Consequently the basic introduction was included in a follow on unit that is core for the Internetworking and Security degree only. Quality of Service (QoS) is a significant topic within VoIP and this was found to map well with an existing optional unit that already included QoS. The concepts of call routing, dial-plans and toll saving seemed logical applications for a WAN environment and thus these topics were incorporated within an existing wide area network optional unit. Although most of the learning objectives or topics were handled within optional units and thus it was possible that some students would miss portions of the VoIP curriculum, it was decided that this was essential as the optional units had very strong fits with the new topics. One of the arguments for integrated VoIP within existing units was that the subject could be treated at a higher level and with more depth than could be achieved with a single dedicated VoIP unit.

### 2.6 Mapping learning objectives to existing units

At this stage the necessary learning objectives have been mapped to the existing units and the remaining task is to ensure that the new learning objectives integrate cleanly with the existing topics. Technologies that lend themselves to being taught across existing units usually do so because they are applications of the existing technology or they form a new context. Integration will be most successful if the delivery can reflect these characteristics`.

#### 2.6.1 VoIP project example

The treatment of VoIP QoS was an area in which it was apparent that there were strong synergies between the existing unit and the new topics. Although the QoS requirements for voice were a necessary inclusion in the revised unit, this was relatively minor in terms of content and learning. A more significant change was the inclusion of real voice traffic in existing QoS labs which not only illustrated the requirements for voice but also provided a far more meaningful QoS experience.

## 3. Conclusion

The model presented in this paper provides a structured approach to integrating new curriculum within the existing unit structures of an educational program. While it's adoption is no guarantee that successful integration is possible, it will ensure that that the essential relationships between the learning objectives and the existing units is understood and thus the overall result should be a more cohesive and functional curriculum.

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